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January 13, 1997

William F. Caton
Acting Secretary
Federal Communications Commission
1919 M St. N.W.
Washington, D.C. 20554

Re: Ex Parte Filing of Primosphere Limited Partnership in Reply to <u>Ex Parte Filing of Lucent Technologies, Inc. in GN Docket 96-228</u>

Dear Mr. Caton:

Attached hereto is an ex parte statement of Primosphere Limited Partnership in reply to a January 8, 1997, ex parte filing, "Technical Statement of Lucent Technologies, Inc.

If you have any questions, please call me.

Very truly yours,

Robert J. Ungar

cc (w/encl.):
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Technical Statement of Primosphere LP

**Amendment of the Commission's Rules to Establish Part 27,
the Wireless Communications Service ("WCS")
GN Docket No. 96-228**

January 13, 1997

On January 8, 1997 Lucent Technologies filed a letter giving notice of an *ex parte* presentation to the Office of Engineering and Technology with regard to Docket 96-228/Wireless Communications Service. Attached to this letter is a summary of the presentation in the form of a technical statement. This technical statement is severely flawed and, given Lucent's reputation, contains a surprising number of serious engineering errors. Thus the Commission should ignore its recommendations.

The Lucent technical statement contains material addressing three basic issues:

1. Satellite receiver performance in the SDARS band
2. SDARS requirements for protection from WCS operations out-of-band emissions
3. The equipment complexity and costs for WCS services to provide this level of protection.

Primosphere has carefully reviewed the Lucent technical statement and presents the following material in response.

1. SATELLITE RECEIVER PERFORMANCE

Lucent claims, based on its "analysis and experience", that Primosphere requirements are worst case assumptions and are overly conservative. Lucent then proceeds to make incorrect and unsubstantiated technical statements as to the noise temperature of satellite receiver front ends. For example Lucent states that "without an expensive sophisticated cooling mechanism, the Noise Temperature for any receiver front end must exceed the ambient Thermal Noise Temperature of 290°K." This is clearly wrong. Solid state Low Noise Amplifiers (LNA's) with noise temperatures of less than 80° K, or 1 dB Noise Figure, are widely available off the shelf in unit quantities for less than $100. A data sheet for a representative low noise FET amplifier device produced by NEC is attached for reference.

Cryogenically cooled satellite receiver front-ends have never been used in mobile satellite receivers and disappeared years ago from fixed commercial satellite systems. Lucent engineering need only to consult any manufacturer of 2 GHz LNA's to confirm its error. Lucent goes on to state that for an SDARS receiver with "a reasonably good LNA ... a more realistic assumption for the SDARS Noise Temperature is at least 2,000° K ..." These unfounded and erroneous assertions clearly demonstrate that Lucent, regardless of its engineering "experience" in other areas, has no understanding of realistic parameters that go into any satellite down path link calculation. Satellite receivers currently in service and under development for two-way satellite mobile communications systems all operate at noise temperatures well under 400° K[1].

In its satellite down link design Primosphere has estimated its receiver noise temperature to be 200° K. This is based on an SDARS receiver with an LNA noise figure of 1 dB, which is equivalent to 80° K, plus an antenna and resistive loss noise temperature of 120° K, giving a total receiver noise temperature of approximately 200° K.

Even if Primosphere's estimate proves overly optimistic and the SDARS receiver were to have a noise temperature of 300° K this would have only a minor impact on SDARS need for protection from WCS out-of-band emissions. This would only change Primosphere requirements for the out-of-band interference by less than 2 dB.

To operate with a 2,000° K receiver noise temperature the SDARS satellite EIRP would have to be increased by 10 dB. This would increase satellite transmitter, solar array and battery power by a factor of 10, resulting in a satellite bigger than any commercial satellite ever launched or in construction today. Further, Primosphere knows of no satellite system, similar to SDARS, that operates at noise temperatures approaching 2,000° K. If the Lucent estimate of a noise temperature of 2,000° K for satellite receivers were correct there could not be any mobile satellite services. Clearly Lucent does not understand satellite system design.

2. SDARS PROTECTION REQUIREMENTS

Primosphere has allowed a 5%, or approximately 0.2dB, increase in its receiver noise for out-of-band emissions from a single transmitter operating in the WCS bands. This is a reasonable allocation since an SDARS receiver may simultaneously see out-of-band emissions from several WCS transmitters. Since the interference from multiple WCS transmitter is additive, the actual amount of out-of-band emission noise seen by one SDARS receiver will be significantly higher than 0.2 dB. The Lucent assertion that a 2 dB allocation is reasonable is, in fact, unreasonable. This statement again demonstrates Lucent's lack of knowledge of the satellite-to-mobile link environment. If this 2 dB degredation was allowed, either the SDARS satellite transmit power would have to be increased by approximately 60%, which is not technically feasible, or the service

[1] For example the in service systems of Inmarsat and AMSC and the under development systems of Iridium, Globalstar and Odyssey all utilize satellite front ends with noise temperatures under 400° K.

would have to operate with unacceptable link margin. It should also be noted that the 2 dB degradation suggested by Lucent is from a single WCS terminal. At this level a small number of WCS transmitters would totally wipe out SDARS reception in large areas.

Further, Primosphere must deal with interference from sources other than WCS. It is anticipated that additional interferers will be present in the band, such as the Canadian fixed services, which are separate and independent sources of interference from the WCS interference allocation.

With respect to the out-of-band emission requirement, Lucent argues that the values Primosphere assumed are too low for the EIRP required for fixed wireless services. Lucent fails to understand that the actual value of "p" used in the FCC formulae of 70+10Log(p) dB or 43+10Log(p) dB is irrelevant to the problem. The constant is the important parameter. Increasing "p" just says that the out-of-band emission shall increase proportionally to the power increase of the fixed or mobile transmit terminal.

Although Lucent states that it has "performed an in depth analysis using an approach similar to Primosphere", it does not provide any analysis, but only states unsubstantiated results. Lucent claims that its analysis shows that the 43 + 10Log (p) out-of-band emission standard is adequate if sufficiently low EIRP (the value "p") is used. Primosphere agrees, providing that the value of 10Log(p) is less than or equal to 80 dB or a value of p= 10^-8 watts is used. Lucent does not state a value for "p."

Lucent acknowledges that a "few cases" of interference may occur in which case it suggests that the WCS and SDARS applicants, who were successful in bidding a considerable large sum of money to obtain a license to operate, should "mutually cooperate with each other and where appropriate and reasonable, implement avoidance techniques, such as antenna position, antenna directionality, or extra filtering." Primosphere has some difficulty in determining what Lucent means when it talks about "antenna position" and "antenna directionality." The SDARS receive antenna is essentially an omnidirectional toroidal wide beam antenna. Changing its position or directivity has no meaning. Changing the fixed WCS services antenna position and directivity will not provide any significant improvement to SDARS services, since the SDARS mobile receivers can be located anywhere and will always be vulnerable to being in the main beam of a WCS fixed service antenna. Clearly, Lucent confuses co-ordination between WCS and SDARS, a mobile service characterized by omnidirectional antennas, with coordination between two fixed services with directional antennas, a situation with which it is perhaps more familiar.

Primosphere agrees with Lucent that the technical issues with regard to WCS out-of-band emission interference with SDARS can be resolved. However, Primosphere asks that these issues be resolved now, not after the allocations are made, licenses awarded and millions of dollars are spent in system deployment.

The out-of-band emission requirements proposed by Primosphere are reasonable, necessary to protect SDARS from interference and can be implemented in an economic manner. Improving transmitter out-of-band filtering coupled with spectrum shaping and cross polarization can be used to meet the out-of-band emission requirements proposed by Primosphere.

3. COMPLEXITY OF WCS TRANSMIT EQUIPMENT TO MEET REQUIRED SDARS OUT-OF-BAND EMISSION LEVELS

The Lucent technical statement focuses solely on brute force output filtering as a means of controlling out-of-band emissions. It completely ignore spectrum shaping, pre-final amplifier filtering, cross polarization and frequency planning. Lucent also concentrates on the 70+10Log(p) out-of-band emission standard, proposed for fixed services, Primosphere, although very concerned with the "70" number for fixed services, is more concerned with the mobile number of "43" Lucent dismisses the "43" number by just saying that "it can be met without special filtering and therefore there is essentially no filter cost". As Primosphere has stated the number "43" needs to be increased to "123" which can be accomplished, without any major cost impact.

Specifically, Primosphere has stated that there are many engineering options to meet the requirement of 123+10Log(p) dB for mobile transmissions. For example, Primosphere notes that use of a square root raised cosine function for pulse shaping is one easily implemented technique that can significantly reduce out-of-band emissions. This spectrum will result in spectrum fall off as given in Figure 1. It can be seen that spectrum fall off at 3 times the transmission symbol rate away will be 65 dB prior to amplification. With non-linear post amplification these levels rise by approximately 10 dB with 4 dB amplifier input back-off. Taking 65 dB as the result of signal shaping, adding filtering of 55 dB at three times the symbol rate away from SDARS band edge and assuming cross-polarization of 15 dB, then the spectrum of the WCS transmission at the SDARS band will fall off by 125 dB. Similar numbers can be developed for the WCS fixed service allocation, in order to comply with the Primosphere recommended number of 90+10Log(p) dB.

In its analysis Primosphere has assumed that the Commission will divide the WCS bands into 5 MHz transmit/receive segments plus within these segments WCS operators will further sub-divide and the two 5 MHz band segments adjacent to the SDARS band will be allocated to mobile receive applications. This makes filtering straight forward and not expensive for the WCS mobile terminals. Lucent has implied a similar arrangement in their technical statement. Thus, Lucent has not shown that the numbers proposed by Primosphere cannot be met in an economical way.

In summary, the Lucent technical statement is wrong in its analysis of SDARS receiver performance, underestimates the need for SDARS protection, and fails to consider several well proven techniques for reducing transmitter out-of-band emissions. As a result it contains misleading information and erroneously concludes that SDARS would be unaffected by WCS out-of-band emissions. The conclusions drawn by Lucent do not have a sound engineering basis and should be rejected.

72827

Typical LNA

NEC

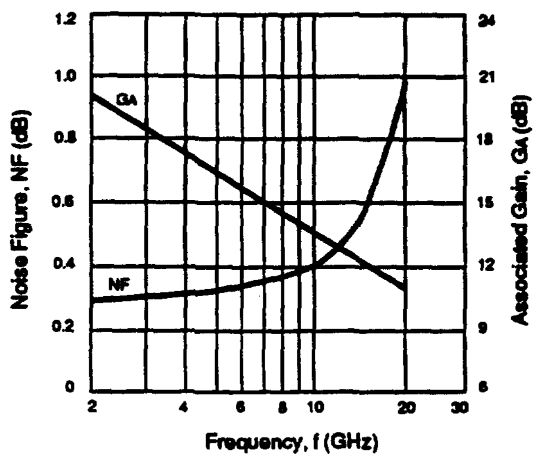
ULTRA LOW NOISE PSEUDOMORPHIC HJ FET

NE32584C

FEATURES

- **VERY LOW NOISE FIGURE:** 0.45 dB Typical at 12 GHz
- **HIGH ASSOCIATED GAIN:** 12.5 dB Typical at 12 GHz
- **$L_G \leq 0.20$ µm, $W_G = 200$ µm**
- **LOW COST METAL CERAMIC PACKAGE**
- **TAPE & REEL PACKAGING OPTION AVAILABLE**

NOISE FIGURE & ASSOCIATED GAIN vs. FREQUENCY
V_{DS} = 2 V, I_{DS} = 10 mA



DESCRIPTION

The NE32584C is a pseudomorphic Hetero-Junction FET that uses the junction between Si-doped AlGaAs and undoped InGaAs to create very high mobility electrons. The device features mushroom shaped TiAl gates for decreased gate resistance and improved power handling capabilities. The mushroom gate also results in lower noise figure and high associated gain. This device is housed in an epoxy-sealed, metal/ceramic package and is intended for high volume consumer and industrial applications.

NEC's stringent quality assurance and test procedures assure the highest reliability and performance.

ELECTRICAL CHARACTERISTICS (T_A = 25°C)

PART NUMBER PACKAGE OUTLINE			NE32584C 84C		
SYMBOLS	PARAMETERS AND CONDITIONS	UNITS	MIN	TYP	MAX
NF[1]	Optimum Noise Figure, V_{DS} = 2 V, I_{DS} = 10 mA, f = 12 GHz	dB		0.45	0.55
GA[1]	Associated Gain, V_{DS} = 2 V, I_{DS} = 10 mA, f = 12 GHz	dB	11.0	12.5	
I_{DSS}	Saturated Drain Current, V_{DS} = 2 V, V_{GS} = 0 V	mA	20	60	90
V_P	Pinch-off Voltage, V_{DS} = 2 V, I_{DS} = 100 µA	V	-2.0	-0.7	-0.2
g_m	Transconductance, V_{DS} = 2 V, I_D = 10 mA	mS	45	60	
I_{GSO}	Gate to Source Leakage Current, V_{GS} = -3 V	µA		0.5	10.0
$R_{TH(CH-A)}$	Thermal Resistance (Channel to Ambient)	°C/W		750	
$R_{TH(CH-C)}$	Thermal Resistance (Channel to Case)	°C/W			350

Note:
1. Typical values of noise figures and associated gain are those obtained when 50% of the devices from a large number of lots were individually measured in a circuit with the input individually tuned to obtain the minimum value. Maximum values are criteria established on the production line as a "go-no-go" screening tuned for the "generic" type but not each specimen.

FIR Implementation of Square Root Raised Cosine Filter

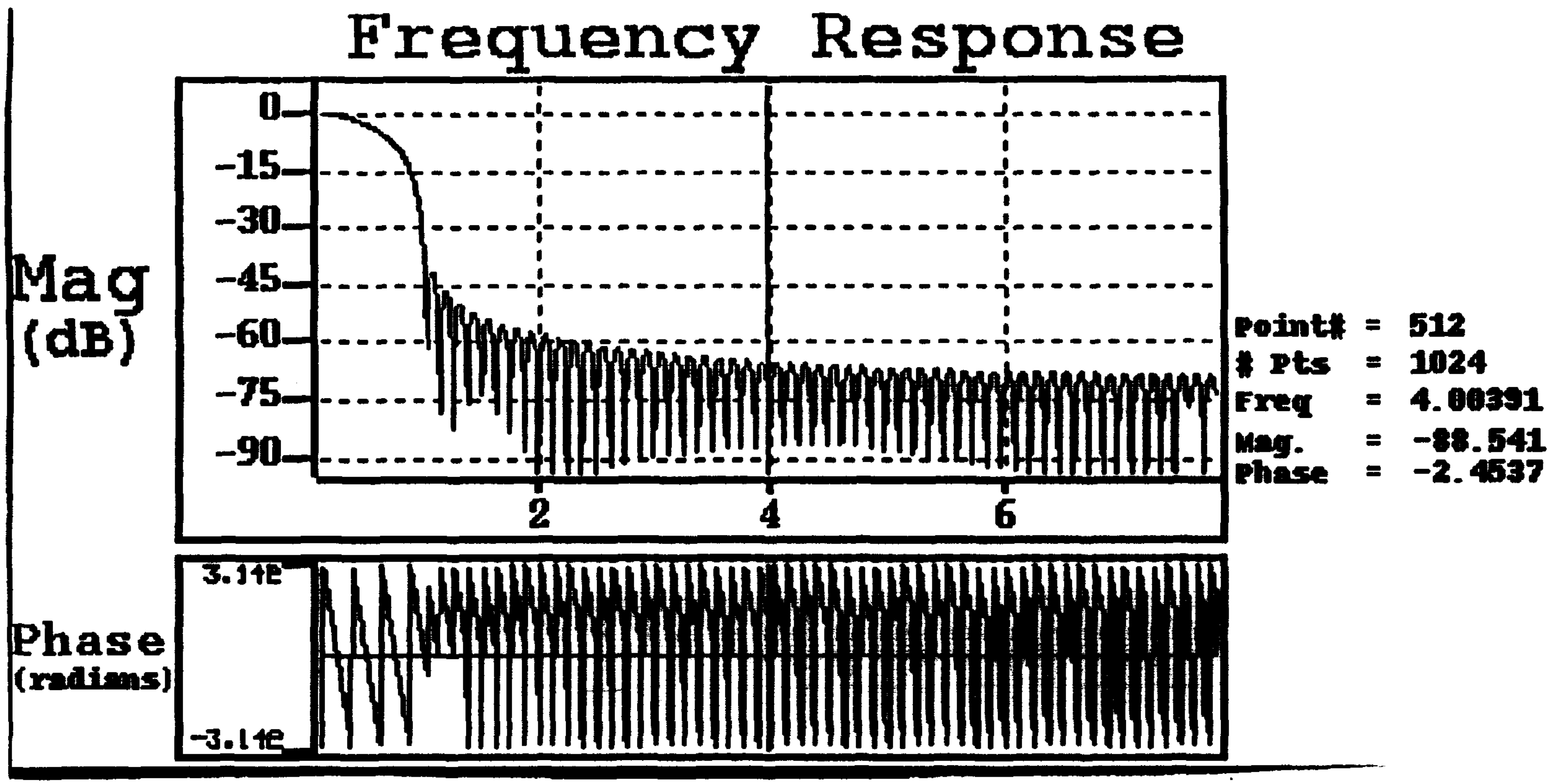


Figure 1